Permalink/DOI: http://dx.doi.org/10.17358/IJBE.6.1.97
Available online at http://journal.ipb.ac.id/index.php/ijbe
Accredited SINTA 2
by Ministry of RTHE Number 30/E/KPT/2018

EL NINO AND DETERMINANTS OF THE OUTPUT OF MICRO AND SMALL INDUSTRY IN JAVA

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Abstract: Micro and small industry sector plays an important role in the economy of a country including Indonesia, due to its large contribution to gross domestic product and its large labor absorption. The output of the sector is influenced by economic variables and non-economic factors such as the El Nino climate phenomenon. The purpose of this study is to analyze the impact of these economic factors and the climate phenomenon on the output of micro and small industries in Java by using panel data, which are combination of cross section and time series, i.e. 6 provinces of Java from 2011 to 2017. The results showed that these economic factors have positive effect on the output while El Nino has negative effect. In accordance with these results, the government needs to actively facilitate micro and small industries in the fulfillment of economic factors and assist the business actors in anticipating and mitigating the impact of El Nino.

Keywords: Economic factors, El Nino, micro and small industry, panel data method

Abstrak: *Sektor industri mikro dan kecil memegang peranan penting dalam perekonomian Indonesia, karena kontribusinya yang besar terhadap produk domestik bruto dan serapan tenaga kerja. Output sektor tersebut dipengaruhi oleh faktor ekonomi dan faktor non-ekonomi termasuk fenomena iklim El Nino. Tujuan penelitian ini adalah menganalisis pengaruh faktor ekonomi dan fenomena iklim tersebut terhadap output industri mikro dan kecil yang berlokasi khususnya di Pulau Jawa dengan menggunakan panel data. Data yang digunakan merupakan gabungan cross section (6 provinsi di Pulau Jawa) dan time series (tahun 2011-2017). Hasil penelitian menunjukkan bahwa faktor ekonomi berpengaruh positif terhadap produksi industri mikro dan kecil, sedangkan El Nino berpengaruh negatif. Terkait hal ini pemerintah perlu aktif memfasilitasi industri mikro dan kecil dalam pemenuhan/akses terhadap faktor-faktor ekonomi, serta membantu pelaku usaha industri mikro dan kecil dalam mengantisipasi dan memitigasi dampak El Nino.*

Kata kunci: *El Nino, metode data panel, faktor ekonomi, industri mikro dan kecil*

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INTRODUCTION

The micro and small industry (MSI) sector plays an important role in the economy of a country by contributing to push the economy in a positive direction (BPS, 2017). The MSI sector can absorb more labor compared to the formal sector. Furthermore, the MSI sector pushes industrialization, increases the quality of human resources, optimizes the use of natural resources, increases and distributes income, and increases economic growth in relatively rural areas.

Micro, small, and medium enterprises (MSME) contribute largely to the national economy. According to data accrued by Badan Pusat Statistik (BPS) in 2016, the MSME sector's contribution towards Gross Domestic Products (GDP) reaches 60.34%. Viewed from workforce perspective, the MSME sector can absorb 57,9 million labor in various areas of Indonesia. Kuncoro (2008) has stated that there are four advantages of MSME that may withstand economy crisis, which are: (1) these enterprises do not require loans from overseas, unlike bigger corporations; (2) they do not have sizeable debt to banks because they are considered unbankable; (3) almost all input used in the process utilizes local products; and (4) a good and promising export orientation base.

According to Susilo (2010) the main problem faced by MSME is low productivity. Other than having a lot of business units, MSMEs are able to absorb more labor compared to big enterprises. However, big enterprises contribute more to the GDP compared to MSME. To simplify, a smaller amount of earnings are divided among more workers, causing lower productivity (earnings or production per worker). Other factors that inhibit the increase of MSME productivity are limitations to access for loans, access to the market, and access to information of resources and technology (Susilo, 2007).

According to Tambunan (2008) one characteristic of a highly competitive MSME is the tendency to have production volume increase. This leads to the conclusion that the production growth rate in a certain timeframe can be used as an indicator to measure competitiveness. In his research about factors that influence MSME competitiveness in Bulgaria, Ahmedova (2015) states that a profitable business condition is the main aspect that affects competitiveness. These conditions consist of several key factors, such as: the government, the quality of the institution, infrastructure, technology and innovation growth, and quality of human resources. Furthermore, Asia Competitiveness Institute (ACI) of the Lee Kuan Yew School of Public Policy defines competitiveness according to four conditions: macroeconomic stability, condition of the government, quality of human resources, business, and finances, and quality of the infrastructure (Tan and Amri, 2013).

As described above, several key factors are needed to create acceptable competitiveness for both micro and small industries. Subpar conditions of the factors above may hinder MSI competitiveness. Other than the factors mentioned above, MSI performance is also influenced by nature. Natural phenomenons such as El Nino may cause drought and significantly decrease rainfall, which affects MSI competitiveness in Indonesia, especially Java, considering the fact that most Indonesian citizens reside in Java, whereby the effect of El Nino existed. Thus the problem formulation for this research is how economic factors as mentioned above and non-economic factors such as El Nino influence MSI output in Java.

Fajri et al. (2019) found that El Nino significantly affects the increase in food prices due to decreased agricultural output, but their study was conducted mainly in the food crop subsector. This study, on the other hand, will focus on the El Nino impact on inflation through its effects on output of small and micro industries. We hypothesize that the occurrence of El Nino will have a negative impact on MSI output. Based on previous studies, the influence of variables related to infrastructure and human resources on MSI output is positive, whereas macroeconomic indicators such as inflation might have a positive impact on MSI production if the effect of inflation on MSI revenues is greater than its effect on costs. The results from this study are expected to fill the research gap, especially in the scope of the research theme of the El Nino impact on MSI output.

METHODS

The data used are panel data, which are a combination of cross-section and time series. Since most micro and small scale industries in Indonesia are located in Java, this research just included provinces in Java, such as DKI Jakarta, West Java, Central Java, East Java,

Yogyakarta, and Banten in the period from 2011 to 2017. Therefore, the scope of the research will focus on provinces in Java.

The dependent variable in this research was output or production variable, which was measured with micro and small-scale industrial production index. We use this index because we cannot directly carry out the data aggregation on MSI productions that have different types of units of measurement. Economic factors included were the conditions mentioned in the background above, such as macroeconomic conditions observed as inflation, human resources and technology development which is measurable with Human Development Index, and infrastructure condition which is measurable with proxy of the ratio of road length compared to area size. The use of road length to area size ratio was based on a study by Vidyattama (2010). Moreover, non-economic factors such as El Nino was measured with the ENSO index, which uses the sea level temperature in the Nino 3.4 region at the Pacific Ocean. All data variables were secondary province data. The variables source and explanation is described in Table 1.

This research used a panel regression analysis method, which combined cross section and time series. Other than eliminating the problem of multicolinierity in the estimated model, the main advantage of using panel data regression is increasing the estimation efficiency because degrees of freedom increased. The following equation is the model utilized to answer the goals of this research.

$$LnPIMSSI_{it} = \alpha + \beta_1 LnCPI_{it} + \beta_2 LnHDI_{it} + \beta_3 LnInfra_{it} + \beta_4 LnENSO_{it} + u_{it}$$

Annotation: LnPIMSSIit (Production index of micro and small-scale industries in province-i in year-t); LnCPIit (Consumer price index in province-i in year-t); LnHDIit (Human development index in province-i in year-t); LnInfrait (Infrastructure condition proxy of road length in province-i in year-t); LnENSOit (El Nino index in province-i in year-t); α, β, uit (Intercept, regression coefficients, error term); i,t (Subscript for cross section and time series, respectively).

RESULTS

This discussion begins with presenting the amount of business and workforce of micro and small industries (MSI). As presented in Figure 1, in 2016 Java houses 64% of all businesses and 67% of all micro and small scale industries in Indonesia. This number is similar to the total citizens in Indonesia who lives in Java and Java's share of Indonesia's GDP. This shows a large contribution of Java towards Indonesia's economy and the centralization of economy.

Figure 2 describes the movement in production index of MSI in 6 provinces in Java between 2011 until 2017. It can be observed in Figure 2 that the province with the highest MSI production is DKI Jakarta, followed by DI Yogyakarta and Banten. Unfortunately, due to limited provincial data we cannot assess the MSI sub-sectoral shares in each province. Therefore we cannot show whether MSI in the three provinces focuses or not on processing outputs of agricultural sector that is more vulnerable to the El Nino. In general, however, much of MSI in these provinces processes foodcrop production to become the MSI outputs. West Java (Jawa Barat), Central Java (Jawa Tengah), and East Java (Jawa Timur) are three provinces in Java with the highest number of business units and workforce with the lowest MSI production growth.

Table 1.Variables in this research and the explanation

Variable	Annotation	Unit	Source
PIMSSI	Production index of micro and small scale industries (year 2010)	Index	Statistics Indonesia (BPS)
CPI	Consumer price index in province capital (year 2012)	Index	BPS
HDI	Human development index	Index	BPS
Infrastructure	The ratio between road length and area size of the province	Km / Km^2	BPS
ENSO	El Nino Southern Oscillation (ENSO) index to measure El Nino intensity	Indeks	National Oceanic and Atmospheric Administration

Choosing the Best Model

Panel data analysis can be undertaken by using three approaches. The first approach is Pooled Least Square (PLS) where it is assumed that there is no individual variance that is represented by a constant intercept value for every observation. The second approach is Fixed Effect Model (FEM), which assumes there is individual heterogeneity and it is represented as different intercepts between individuals. Statistically FEM is relevant if it is proved there is no correlation between individual effect with independent variables. The last approach is Random Effect Model (REM) is relevant to use if there is a correlation between individual effects to independent variables. Panel models with REM approach technically requires sufficient cross section. REM approach could not be used in this discussion because of insufficient cross section. Therefore only two approaches could be applied in this research, which were PLS and FEM, tested with the Chow test. The probability of Chow Test was 0.0726 which was greater than the significance level α=5%. This means the PLS approach was more appropriate for this research compared to FEM, suggesting there were no individual heterogenity in the estimated model.

Normality Test

Normality test was completed with the Jarque Bera test. The results found a p-value of 0.4155, which is greater than the 5% significance level. This shows that the estimated model has a normally distributed error.

Multicolinearity Test

Testing of multicolinearity presence in the estimated model is a way to discover a linier relationship amongst independent variables. Determining multicolinearity can be achieved by measuring Pearson correlation coefficient with the correlation result between independent variables below 0.8 (Table 2).

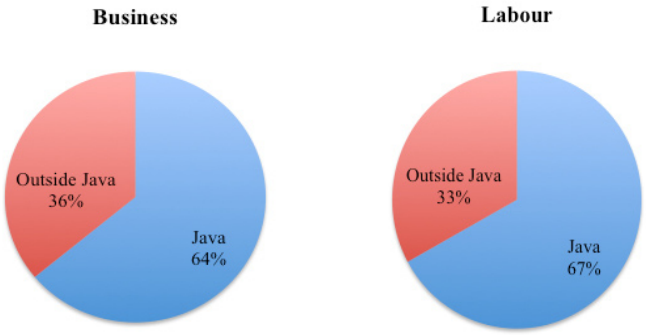

Figure 1. Comparison of total businesses and workforce of MSI in Java and Outside Java in 2016 (BPS, 2017)

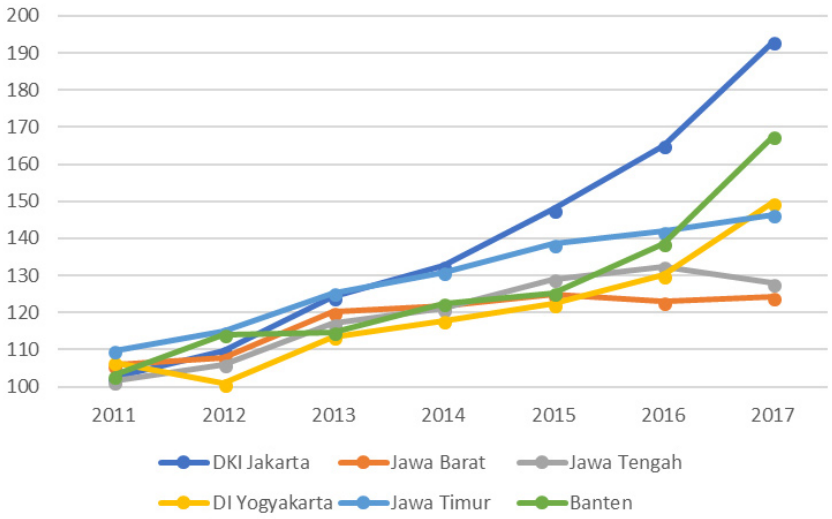

Figure 2. Movement of production Index of micro and small industries in provinces of Java (BPS, 2017)

Heteroscedasticity Test

Heteroscedasticity may cause the estimator to have no minimum variance, where the regression coefficients remain unbiased however variance of the residuals is no longer minimum (Gujarati et al. 2011). Hence, hypothesis testing, for example F test and t test, becomes biased. The GLS Weight Cross-section SUR can be used to overcome the problem of heteroscedasticity. Heteroscedasticity test results show p-value in cross section of 0.1632 and in time series test of 0.0013. This shows there was a violation of the assumption of homoscedasticity. To correct this problem, we use the GLS of Weight Cross-section SUR as the estimation method for the model.

Autocorrelation Test

Autocorrelation is a form of violation of assumptions in regression models where a correlation between residuals exists. If autocorrelation is observed, regression coefficients are unbiased, however variance of the residuals is not minimal, and hence the estimator is no longer efficient. Since the GLS Weight Cross-section SUR method is applied for estimating the model, if autocorrelation did exist, the problem is automatically corrected (Gujarati et al. 2011).

Estimation Results

The results of estimated model of MSI production determinants in Java with PLS approach using the GLS Weight Crosssection SUR is described in Table 3. To summarize, the results of estimation have R2 value of 0.9896. This shows that variables such as inflation, human resources, infrastructure, and El Nino can explain the varied production of micro and small scale industries of 98.96%, and the 1.04% varied production is explained by residuals.

Table 3 shows inflation positively and significantly influences MSI output with a 1% significance level. Inflation increase of 1% increases MSSI output of 1.24%, ceteris paribus. As for inflation that positively impacts production is a low and stable inflation that shows a stable macroeconomic condition that becomes an incentive for producers to increase production. Bulman and Simon (2003) found that industrial structure also has a role in explaining the effect of inflation on productivity and hence on output. An increase in inflation causes a less certain environment for planning, greater cash-flow pressure, an increase in real investment in inventories, delay in account payments, and greater bad debts. In large industries, these things are assumed to be more complex, resulting in large additional management costs and can reduce productivity. But for industries that are dominated by small companies, firms can enter and exit the industry freely. The increase in inflation that caused the above problems causes small companies that are less efficient to exit from the industry. Thus on average, the productivity in the industry has increased.

Basically, from the supply theory, the level of price of goods does have a positive effect on supply or production. However, since the variable used here is inflation then increases in price occur in both inputs and outputs. Thus, the positive effect of an increase in inflation on an increase in production is likely due to an increase in producer income due to higher inflation than the increase in costs. But this prove is not the scope of our study. Here we show the data of inflation that increase each year in each province (Table 4.)

Table 2. Pearson correlation coefficients among the variables

	PIMSSI	CPI	HDI	Infra
CPI	0.809			
HDI	0.382	0.244		
Infra	0.318	-0.004	0.700	
ENSO	0.330	0.530	0.133	-0.004

Table 3. Estimated model of micro and small-scale industry production

Variable	Coefficient	Standard Error	t-Statistic	Prob
LnIHK	1.2382	0.0232	53.2940	0.0000***
LnIPM	8.9591	1.3896	6.4474	0.0000***
LnInfra	0.0438	0.0094	4.6531	0.0000***
LnENSO	-0.6936	0.1026	-6.7586	0.0000***
C	1.1788	0.2871	4.1067	0.0002***
R^2	0.9896	Mean dependent var		169.6854
Adj-R^2	0.9885	S.D. dependent var		368.5443
S.E. of regression	1.0345	Sum squared resid		39.5995
F-statistic	883.2669	Durbin-Watson stat		1.8170
Prob(F-statistic)	0.0000			

*** significant at 1%

Table 4 shows the inflation rate is relatively low and stable between 2012 until 2017 in provinces in Java. Therefore, this justifies our hypothesis for the positive effect of inflation on MSI output. This result is similar to that in Tan and Amri (2013) that states macroeconomic stability including of inflation is vital to maintain competitiveness and increase production.

Referring back to Table 3, the next variable that affects MSI output is human resource that was measured with the human development index (HDI). Estimated results show that HDI positively and significantly affects MSI output at a 1% significance level. HDI increase of 1% may increase MSI output of 8.96%, ceteris paribus. This result is in line with our hypothesis. This result is also similar to that in Ahmedova (2015) that higher quality human resources will push innovation and technology application. Innovation plays an important role in relation to the ability of business owners to adapt with the external environment in, including with the climate change. The continuity of micro and small-scale industries relies heavily on the business owner's ability to innovate and to adapt. Furthermore, the application of technology is important for economic growth in Indonesia especially in the micro and small industry sector, because of its large role in Indonesia economy. According to data, six provinces in Java hold the highest 15 HDI in Indonesia, however only DKI Jakarta, DI Yogyakarta, and Banten have a higher HDI than national HDI (Figure 3).

The variable of infrastructure proxied by road length positively impact MSI output with a 1% significance level. An increase of road length by 1% will increase MSI output by 0.04%, ceteris paribus. Besides proving our hypothesis, this result is also similar to Tan and Amri (2013) that infrastructure is very important in economic growth in Indonesia. Because infrastructure holds an important role in product distribution, therefore the improvement of infrastructure condition will expedite product distribution and cut travel time. The cost cutting will cause a decrease of product price in the market. This is sensitive to micro and small-scale industries in an effort to increase production. Furthermore, infrastructure improvement will impact in lowering of transportation costs causing in the increase of trading volume and facilitate the transfer of technology and information.

Table 4. Inflation in provinces in Java between 2012 until 2017 (percentage)

Province	2012	2013	2014	2015	2016	2017
DKI Jakarta	4.17	6.77	6.18	6.78	2.96	3.63
West Java	4.28	6.56	5.10	6.42	3.47	3.47
Central Java	4.52	7.07	5.48	5.72	3.01	3.66
DI Yogyakarta	3.88	6.74	5.40	5.08	3.06	3.70
East Java	4.53	6.76	5.49	6.36	3.40	4.39
Banten	4.34	8.21	6.85	8.20	4.84	4.69

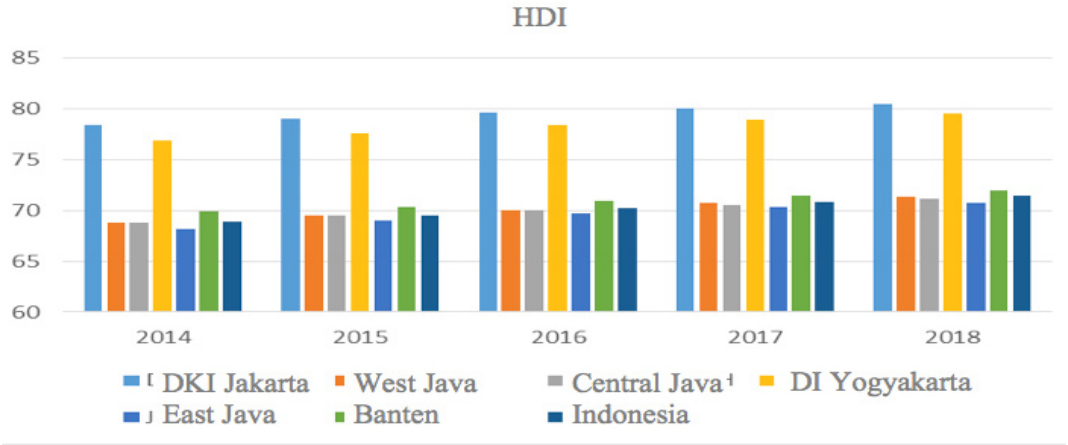

Figure 3. HDI Growth in Provinces in Java

The next discussion is the influence of El Nino as a non-economic factor towards MSI output. Estimated results show that El Nino significantly and negatively impact MSI output at a 1% significance level. El Nino increase in the form of ENSO index increase of 1% may decrease MSI output as much as 0.69%, ceteris paribus. This negative effect shows that non-economic factors such as El Nino may inhibit the micro and small-scale industries output in Java which is directly affected by El Nino. This result is generally similar to results of a study by Cashin et al. (2015) that a relative short term decrease in output is observed during El Nino, including in Indonesia. Furthermore, small business owners are relatively more vulnerable to natural disturbances compared to big corporations. Small business owners usually do not have planning to anticipate climate change. Especially nationally, the majority of MSME (56%) in Indonesia is on agricultural sector such as foods, beverages, rubber, tobacco, wood, and paper and paper products. Previous studies have stated that the agriculture sector is the most vulnerable sector affected by the climate change. Therefore, it is suggested that small business owners compiles their business plan while accounting to the possible risks of climate change, because climate fluctuation and intensity is unable to be controlled.

Managerial Implications

This study provides additional empirical evidence that El Nino can affect the production of micro and small-scale industries in Java. Small business owners are relatively more vulnerable to natural disturbances compared to big corporations, partly because they usually do not have planning to anticipate climate change. Previous studies have stated that the agriculture sector is the most vulnerable sector affected by the climate change, and as it turns out, the majority of MSME (56%) in Indonesia is on agricultural sector such as foods, beverages, rubber, tobacco, wood, and paper and paper products. Therefore, it is suggested that small business owners compiles their business plan while accounting to the possible risks of climate change, because climate fluctuation and intensity is unable to be controlled.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Inflation, human resources, and infrastructure positively determine production of micro and small-scale industries (MSI) in Java, while El Nino as non-economic factor has negative influence on output. This insinuates that factors, such as macroeconomic stability, human resource quality (and of course technology development and innovation), and infrastructure play important roles in maintaining and increasing the output of micro and small-scale industries. To increase MSI output, which is vital due to its roles on the national economy, the government should support the MSI competitiveness by identifying and then overcoming certain factors that become bottlenecks for a specific micro and small-scale industry. This among others would need a development of database of MSI players in each region.

Recommendations

The negative influence of El Nino on output means that the rise in El Nino intensity may inhibit output and ultimately competitiveness of micro and small-scale industries in Java. Due to the fact that most micro and small-scale businesses do not have a planned adaptation to climate change, it is important for the government to assist them in constructing a business plan with climate change risks in mind. Additionally, the MSI businesses themselves would also need to support climate change mitigation. For this, the government should again assist the MSI producers to operate in sustainable manner, for instance by urging them in using clean energy sources in their production processes in order to reduce emissions of the green house gasses.

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